Ulysses Observations of Differential Streaming Between Protons and Alphas at High Latitudes

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The Ulysses SWOOPS experiment has provided measurements of the differential streaming between protons and alphas, $V_{\alpha p} = -V_\alpha - V_p$ as a function of heliocentric distance and latitude. We report here the observations of $V_{\alpha p}$ for those periods when Ulysses sampled only the flows from the solar polar coronal holes. The data show that $V_{\alpha p}$ depends on heliocentric distance R approximately as R^{-1} and has no discernible latitude dependence for $\lambda = \pm(40 to 80°)$. The radial variation matches up nicely with that measured by Helios between 0.3 and 1.0 AU for periods when the solar wind speed was in the range 700-800 km/s. The ratio $V_{\alpha p}/V_A$, **where VA** is the Alfven speed, also decreases with distance, from 0.7 at 1.5 AU to 0.5 at 4 AU. At the same time, the rat io $V_{\alpha p}/V_{wave}$, where V_{wave} is the observed phase velocity of Alfvenic fluctuations, decreases from 1.4 at 1.5 AU to 1.0 at 4 AU. There is a correlation between $V_{\alpha p}$ and the wave intensity for fluctuations with periods of 8 min to 6 hours. All these high-latitude results are very different from those obtained during the outbound, in-ecliptic phase of the Ulysses mission.

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